

## Claims

## 1. A composition comprising

A) a thermoplastic polymer and

B1) a triblock-copolymer of the formula B-C-B; or

B2) a graft copolymer wherein a polymer block B is grafted onto a polymer C to form a comb copolymer of idealized formula C-B(n) wherein n is greater than 2;

wherein

the polymer block B is compatible to the thermoplastic polymer A); and

the polymer block C has a glass transition temperature of at least 20° K below the glass transition temperature of the thermoplastic polymer A);

and the average molecular weight  $M_w$  of the triblock-copolymer B1) or grafted comb copolymer B2) is below 50 000.

2. A composition according to claim 1 wherein the thermoplastic polymer A is selected from the group consisting of polyethylene, polypropylene, polystyrene, polyacrylate, polymethacrylate, polyvinylchloride, polyphenyleneoxide, polyvinylacetate, polyamide and polyester

3. A composition according to claim 1 wherein the block polymer C is selected from the group consisting of poly-n-butylacrylate, polyisoprene, polybutadiene, polyethylacrylate, and polysiloxane.

4. A composition according to claim 1 wherein the polymer block B is selected from the group consisting of polyisoprene, polybutadiene, polystyrene polymethacrylate and polyacrylate.

## 5. A composition according to claim 1 wherein

the thermoplastic polymer A

polystyrene

polystyrene

polystyrene

polystyrene

polystyrene

polyethylene

polypropylene

and the triblock-copolymer B-C-B are

polystyrene-poly-n-butylacrylate-polystyrene,

polystyrene-polyisoprene-polystyrene,

polystyrene-polybutadiene-polystyrene,

polystyrene-polysiloxane-polystyrene,

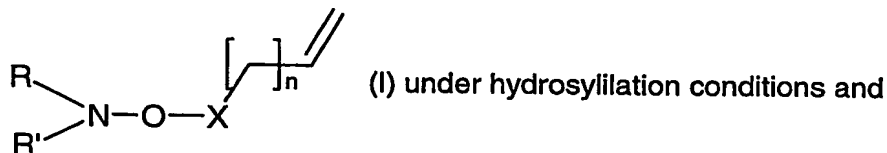
polystyrene-polyethylacrylate-polystyrene,

polyisoprene-polysiloxane-polyisoprene,

polyisoprene-polysiloxane-polyisoprene,

polymethylmethacrylate	polymethylacrylate-polysiloxane-polymethylacrylate,
polyamide	polyethylacrylate-polysiloxane-polyethylacrylate,
polyester	polyethylacrylate-polysiloxane-polyethylacrylate,
polyvinylchloride	polyethylacrylate-polysiloxane-polyethylacrylate,
polyvinylchloride	poly-n-butylacrylate-polysiloxane-poly-n-butylacrylate,
polyphenyleneoxide	polystyrene-polysiloxane-polystyrene or
polyvinylacetate	polymethylacrylate-polysiloxane-polymethylacrylate.

6. A composition according to claim 1 wherein the glass transition temperature of the polymer block C is 50° K below the glass transition temperature of the thermoplastic polymer A.
7. A composition according to claim 1 wherein the average molecular weight  $M_w$  of the triblock-copolymer or graft-copolymer is below 30000.
8. A composition according to claim 1 wherein the polymer block C is a polysiloxane.
9. A composition according to claim 1 wherein the triblock-copolymer or graft graft-copolymer is present in an amount of from 0.1 to 10 % by weight, based on the weight of the thermoplastic polymer A).
10. A process for the preparation of a triblock-copolymer or graft graft-copolymer via controlled free radical polymerization comprising the steps of
  - a) reacting a polysiloxane, in the presence of a functional alkoxyamine of formula (I)



- b) reacting the resulting alkoxyamine terminated polysiloxane with an ethylenically unsaturated monomer at a temperature between 60 and 160° C, wherein X represents a group having at least one carbon atom and is such that the free radical

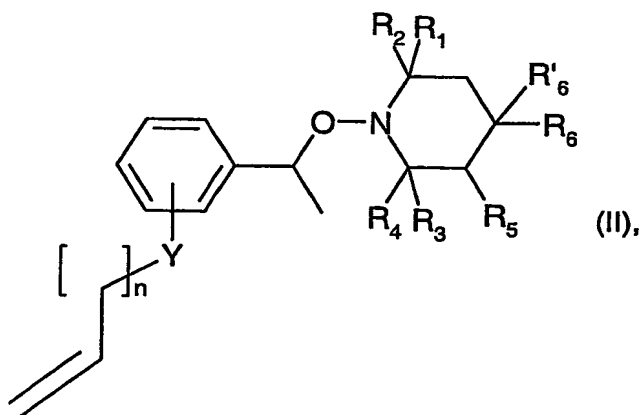


n is a number from 0-18;

R and R' are independently tertiary bound C<sub>4</sub>-C<sub>28</sub>alkyl groups which are unsubstituted or substituted by one or more electron withdrawing groups or by phenyl; or

R and R' together form a 5 or 6 membered heterocyclic ring which is substituted at least by 4 C<sub>1</sub>-C<sub>4</sub>alkyl groups and which may be interrupted by a further nitrogen or oxygen atom.

11. A process according to claim 10 wherein the functional alkoxyamine is of formula (II)



wherein

Y is a direct bond, O, NH, C(O)O or S;

n is a a number from 0-18.

R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub> and R<sub>4</sub> are independently of each other C<sub>1</sub>-C<sub>4</sub>alkyl;

R<sub>5</sub> is hydrogen or C<sub>1</sub>-C<sub>4</sub>alkyl;

R'<sub>6</sub> is hydrogen and R<sub>6</sub> is H, OR<sub>10</sub>, NR<sub>10</sub>R<sub>11</sub>, -O-C(O)-R<sub>10</sub> or NR<sub>11</sub>-C(O)-R<sub>10</sub>;

R<sub>10</sub> and R<sub>11</sub> independently are hydrogen, C<sub>1</sub>-C<sub>18</sub>alkyl, C<sub>2</sub>-C<sub>18</sub>alkenyl, C<sub>2</sub>-C<sub>18</sub>alkinyl or C<sub>2</sub>-C<sub>18</sub>alkyl which is substituted by at least one hydroxy group or, if R<sub>6</sub> is NR<sub>10</sub>R<sub>11</sub>, taken together, form a C<sub>2</sub>-C<sub>12</sub>alkylene bridge or a C<sub>2</sub>-C<sub>12</sub>-alkylene bridge interrupted by at least one O atom; or

R<sub>6</sub> and R'<sub>6</sub> together are both hydrogen, a group =O or =N-O-R<sub>20</sub> wherein

R<sub>20</sub> is H, straight or branched C<sub>1</sub>-C<sub>18</sub>alkyl, C<sub>3</sub>-C<sub>18</sub>alkenyl or C<sub>3</sub>-C<sub>18</sub>alkinyl, which may be unsubstituted or substituted, by one or more OH, C<sub>1</sub>-C<sub>8</sub>alkoxy, carboxy, C<sub>1</sub>-C<sub>8</sub>alkoxycarbonyl; C<sub>5</sub>-C<sub>12</sub>cycloalkyl or C<sub>5</sub>-C<sub>12</sub>cycloalkenyl;

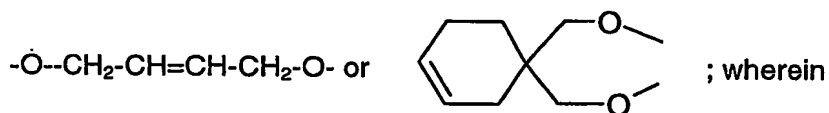
phenyl, C<sub>7</sub>-C<sub>9</sub>phenylalkyl or naphthyl which may be unsubstituted or substituted by one or more C<sub>1</sub>-C<sub>8</sub>alkyl, halogen, OH, C<sub>1</sub>-C<sub>8</sub>alkoxy, carboxy, C<sub>1</sub>-C<sub>8</sub>alkoxycarbonyl;

-C(O)-C<sub>1</sub>-C<sub>36</sub>alkyl, or an acyl moiety of a  $\alpha,\beta$ -unsaturated carboxylic acid having 3 to 5 carbon atoms or of an aromatic carboxylic acid having 7 to 15 carbon atoms;

-SO<sub>3</sub><sup>-</sup>Q<sup>+</sup>, -PO(O<sup>-</sup>Q<sup>+</sup>)<sub>2</sub>, -P(O)(OR<sub>2</sub>)<sub>2</sub>, -SO<sub>2</sub>-R<sub>2</sub>, -CO-NH-R<sub>2</sub>, -CONH<sub>2</sub>, COOR<sub>2</sub>, or Si(Me)<sub>3</sub>, wherein Q<sup>+</sup> is H<sup>+</sup>, ammonium or an alkali metal cation; or

R<sub>6</sub> and R<sub>6</sub>' are independently -O-C<sub>1</sub>-C<sub>12</sub>alkyl, -O-C<sub>3</sub>-C<sub>12</sub>alkenyl, -O-C<sub>3</sub>-C<sub>12</sub>alkinyl, -O-C<sub>5</sub>-C<sub>8</sub>cycloalkyl, -O-phenyl, -O-naphthyl, -O-C<sub>7</sub>-C<sub>9</sub>phenylalkyl; or

R<sub>6</sub> and R<sub>6</sub>' together form one of the bivalent groups -O-C(R<sub>21</sub>)(R<sub>22</sub>)-CH(R<sub>23</sub>)-O-, -O-CH(R<sub>21</sub>)-CH<sub>22</sub>-C(R<sub>22</sub>)(R<sub>23</sub>)-O-, -O-CH(R<sub>22</sub>)-CH<sub>2</sub>-C(R<sub>21</sub>)(R<sub>23</sub>)-O-, -O-CH<sub>2</sub>-C(R<sub>21</sub>)(R<sub>22</sub>)-CH(R<sub>23</sub>)-O-, -O-o-phenylene-O-, -O-1,2-cyclohexyliden-O-,



R<sub>21</sub> is hydrogen, C<sub>1</sub>-C<sub>12</sub>alkyl, COOH, COO-(C<sub>1</sub>-C<sub>12</sub>)alkyl or CH<sub>2</sub>OR<sub>24</sub>;

R<sub>22</sub> and R<sub>23</sub> are independently hydrogen, methyl ethyl, COOH or COO-(C<sub>1</sub>-C<sub>12</sub>)alkyl; and

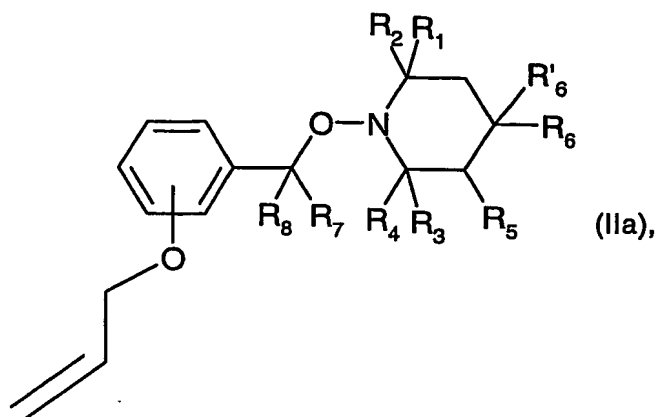
R<sub>24</sub> is hydrogen, C<sub>1</sub>-C<sub>12</sub>alkyl, benzyl, or a monovalent acyl residue derived from an aliphatic, cycloaliphatic or aromatic monocarboxylic acid having up to 18 carbon atoms.

12. A triblock-copolymer or graft-copolymer obtained via a controlled free radical polymerization process according to claim 10.

13. A composition according to claim 1 wherein the triblock-copolymer or graft-copolymer is prepared via controlled free radical polymerization according to claim 9.

14. Use of a triblock-copolymer or graft graft-copolymer prepared according to claim 1 as additive for enhancing the melt flow of thermoplastic polymers during processing.

15. A compound of formula IIa



wherein

$R_1$ ,  $R_2$ ,  $R_3$  and  $R_4$  are independently of each other  $C_1$ - $C_4$ alkyl;

$R_5$  is hydrogen or  $C_1$ - $C_4$ alkyl;

$R'_6$  is hydrogen and  $R_6$  is H,  $OR_{10}$ ,  $NR_{10}R_{11}$ ,  $-O-C(O)-R_{10}$  or  $NR_{11}-C(O)-R_{10}$ ;

$R_{10}$  and  $R_{11}$  independently are hydrogen,  $C_1$ - $C_{18}$ alkyl,  $C_2$ - $C_{18}$ alkenyl,  $C_2$ - $C_{18}$ alkinyl or  $C_2$ - $C_{18}$ alkyl which is substituted by at least one hydroxy group or, if  $R_6$  is  $NR_{10}R_{11}$ , taken together, form a  $C_2$ - $C_{12}$ alkylene bridge or a  $C_2$ - $C_{12}$ -alkylene bridge interrupted by at least one O atom; or

$R_6$  and  $R'_6$  together are both hydrogen, a group  $=O$  or  $=N-O-R_{20}$  wherein

$R_{20}$  is H, straight or branched  $C_1$ - $C_{18}$ alkyl,  $C_3$ - $C_{18}$ alkenyl or  $C_3$ - $C_{18}$ alkinyl, which may be unsubstituted or substituted, by one or more OH,  $C_1$ - $C_8$ alkoxy, carboxy,  $C_1$ - $C_8$ alkoxycarbonyl;  $C_5$ - $C_{12}$ cycloalkyl or  $C_5$ - $C_{12}$ cycloalkenyl;

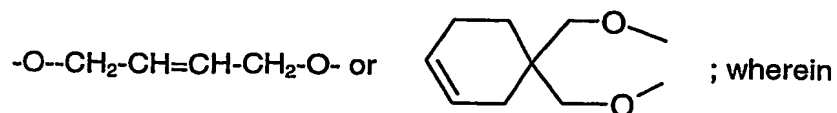
phenyl,  $C_7$ - $C_9$ phenylalkyl or naphthyl which may be unsubstituted or substituted by one or more  $C_1$ - $C_8$ alkyl, halogen, OH,  $C_1$ - $C_8$ alkoxy, carboxy,  $C_1$ - $C_8$ alkoxycarbonyl;

$-C(O)-C_1-C_{36}$ alkyl, or an acyl moiety of a  $\alpha,\beta$ -unsaturated carboxylic acid having 3 to 5 carbon atoms or of an aromatic carboxylic acid having 7 to 15 carbon atoms;

$-SO_3^-Q^+$ ,  $-PO(O^-Q^+)_2$ ,  $-P(O)(OR_2)_2$ ,  $-SO_2-R_2$ ,  $-CO-NH-R_2$ ,  $-CONH_2$ ,  $COOR_2$ , or  $Si(Me)_3$ , wherein  $Q^+$  is  $H^+$ , ammonium or an alkali metal cation; or

$R_6$  and  $R'_6$  are independently  $-O-C_1-C_{12}$ alkyl,  $-O-C_3-C_{12}$ alkenyl,  $-O-C_3-C_{12}$ alkinyl,  $-O-C_5-C_8$ cycloalkyl,  $-O$ -phenyl,  $-O$ -naphthyl,  $-O-C_7-C_9$ phenylalkyl; or

$R_6$  and  $R'_6$  together form one of the bivalent groups  $-O-C(R_{21})(R_{22})-CH(R_{23})-O-$ ,  $-O-CH(R_{21})-CH_2-C(R_{22})(R_{23})-O-$ ,  $-O-CH(R_{22})-CH_2-C(R_{21})(R_{23})-O-$ ,  $-O-CH_2-C(R_{21})(R_{22})-CH(R_{23})-O-$ ,  $-O-o$ -phenylene- $O-$ ,  $-O$ -1,2-cyclohexyliden- $O-$ ,



R<sub>21</sub> is hydrogen, C<sub>1</sub>-C<sub>12</sub>alkyl, COOH, COO-(C<sub>1</sub>-C<sub>12</sub>)alkyl or CH<sub>2</sub>OR<sub>24</sub>;

R<sub>22</sub> and R<sub>23</sub> are independently hydrogen, methyl ethyl, COOH or COO-(C<sub>1</sub>-C<sub>12</sub>)alkyl;

R<sub>24</sub> is hydrogen, C<sub>1</sub>-C<sub>12</sub>alkyl, benzyl, or a monovalent acyl residue derived from an aliphatic, cycloaliphatic or aromatic monocarboxylic acid having up to 18 carbon atoms; and

R<sub>7</sub> and R<sub>8</sub> are independently hydrogen or C<sub>1</sub>-C<sub>18</sub>alkyl.